Win-I2CUSBDLL©

DLL User's Manual

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Win-I2CUSBDLL

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I²C Protocol

General Characteristics

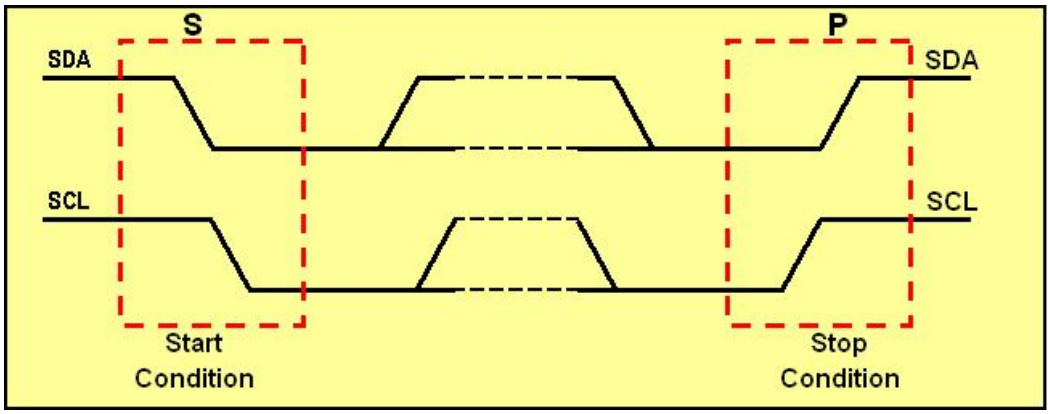
The I²C protocol allows data to be transferred between devices using two open-drain (or open-collector) bi-directional lines. One line is the serial clock (SCL) and the other is the serial data (SDA). The bus master generates the Start conditions, the clock signals on SCL, as well as the Stop condition. An acknowledge (ACK) is transmitted by the receiving device on the bus after each byte is sent.

Bit Transfer

Data on SDA must be stable while SCL is high. The state of SDA when SCL is high determines the logic level of the transmitted data bit.

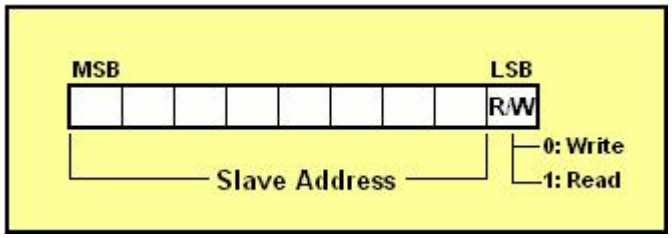
Start and Stop Conditions

Within the procedure of the I²C bus, unique situations arise which are defined as START and STOP conditions. A HIGH to LOW transition on the SDA line while SCL is HIGH is one such unique case. This situation indicates a START condition. A LOW to HIGH transition on the SDA line while SCL is HIGH defines a STOP condition. The master always generates START and STOP conditions. The bus is considered to be busy after the START condition. The bus is considered to be free again a certain time after the STOP condition.



I²C Address

The first seven bits of an I²C transmission, after a Start condition, make up the slave address. The eighth bit (or the least significant bit) is the R/W bit that determines the direction of the message.



A '0' in the least significant position of the first byte means that the master will WRITE information

to the selected slave. A '1' in this position means that the master will READ information from the slave.
When an I²C address is sent, each device in a system compares the first seven bits after the START condition with its own address. If they match, the device considers itself addressed by the master as a slave-receiver or slave-transmitter, depending on the R/W bit.

Subaddress

When an I²C device contains more than one register, the various registers are generally accessed using a subaddress that is sent following the device address (see the I2CWriteArray and I2CReadArray sections below). The subaddress acts like a pointer to the register that needs to be accessed.

Data Transfer

Every byte on the SDA line must be 8-bits long. The number of bytes that can be transmitted per transfer is unrestricted. Each byte must also be followed by an acknowledge bit. Data is transferred with the most significant bit first. If a receiver can't receive another complete byte of data until it has performed some other function, it can hold the clock line SCL low to force the transmitter into a wait state.

Acknowledge

The Acknowledge related clock pulse is generated by the master (Win-I2CUSBDLL is always the bus master). The transmitter releases the SDA line during the acknowledge clock pulse. The receiver must pull down the SDA line during the acknowledge clock pulse so that it remains stable low during the high period of the clock pulse.
The master-receiver signals the end of a read by not acknowledging the last byte it requires.

I²C Bus Documentation

The complete I²C Bus specification can be found at
http://www.semiconductors.philips.com/buses/i2c/.

Win-I2CUSBDLL

Minimum System Configuration

- ✓ PC with a Pentium and 8MB RAM or better
- ✓ Windows 98SE, ME, 2000, or XP
- ✓ 10 MB of free HDD space
- ✓ CD ROM drive (used for installation only)
- ✓ USB port (either 1.1 or 2.0 compatible)

Win-I2CUSBDLL Contents

- Win-I2CUSBDLL installation CD ROM
- Win-I2CUSB Hardware Adapter

Files installed for Win-I2CUSBDLL

- WinI2CUSBpro.dll - this is the actual dll file you will link to your application. The installation process places this file in the appropriate Windows\System folder
- Win-I2CUSBDLL DLL User's Manual (this document)
- Visual C++, Delphi, C++ Builder, and Visual Basic example files
- Win-I2CUSB.exe application
- Win-SPIUSB.exe application
- Win-I2CUSB Software User's Manual
- Win-I2CUSBDLL - QuickStartGuide
- Win-I2CUSB Hardware User's Manual
- Software license agreement (license.txt)
- Registration Form (RegFrmxx.txt)

Location of DLL

The WinI2CUSBpro.dll is placed in the Windows\System32 directory during installation.

Testing the Installation

After Win-I2CUSBDLL has been installed on your hard disk, the installation of the driver can be tested with the included Win-I2CUSB application. The Win-I2CUSB adapter should be inserted into an available USB port, and then the Win-I2CUSB application can be started. If the installation was successful, you will see the "Hardware Detected" message on the screen.
Note that when installing the software to a Windows 2000, or XP system, you must have Administrator privileges or the USB drivers will not be loaded correctly. After the software has successfully been installed, normal user privileges can be restored.

Win-I2CUSBDLL

Exported Functions using the stdcall convention

Most programming languages, such as Visual C++, Delphi, C++ Builder, Visual C#, and Visual Basic, can use the **stdcall** calling convention. The stdcall convention passes the parameters to the functions in the dll from right to left and it is up to the called functions (in this case, the functions in WinI2CUSBpro.dll) to clean up the stack.

General Control Functions

Enable3VOutputPower

The Win-I2CUSB hardware contains a 3.3V output which can be used to supply power to a low-power target. The Win-I2CUSB hardware enumerates as a low power device which means that it draws less than 100mA. The combined current consumption of the target system and the Win-I2CUSB hardware should therefore consume less than 100mA in order to meet this requirement.
The function takes a Boolean false ('0') to disable the output while a true (non-zero value) will enable the output. The function returns true if enabled and false if disabled.
The default value is false (disabled).

```
C/C++:  short int Enable3VOutputPower(short int State)
Delphi: Enable3VoutputPower(State: LongBool): LongBool;
VB:     Enable3VOutputPower(ByVal State As Boolean) As Boolean
```

Enable5VOutputPower

The Win-I2CUSB hardware contains a 5V output which can be used to supply power to a low-power target. The Win-I2CUSB hardware enumerates as a low power device which means that it draws less than 100mA. The combined current consumption of the target system and the Win-I2CUSB hardware should therefore consume less than 100mA in order to meet this requirement.
The function takes a Boolean false ('0') to disable the output while a true (non-zero value) will enable the output. The function returns true if enabled and false if disabled.
The default value is false (disabled).

```
C/C++:  short int Enable5VOutputPower(short int State);
Delphi: Enable5VoutputPower(State: LongBool): LongBool;
VB:     Enable5VOutputPower(ByVal State As Boolean) As Boolean
```

GetFirmwareRevision

The firmware revision can found by using the GetFirmwareRevision function. The revision is returned in BCD format. For example, a value of 0x12 would correspond to firmware version 1.2.

```
C/C++:  uchar GetFirmwareRevision(void)
Delphi: GetFirmwareRevision: byte;
VB:     GetFirmwareRevision() As Byte
```

GetHardwareInfo

This function takes a pointer to an array of bytes which will be loaded with three values:
1. I2C frequency (note that the value returned is the I2C frequency divided by 2)
2. 3.3V Power Output State (0 = 'On' and 1='Off')
3. 5V Power Output State (0 = 'On' and 1='Off')

```
C/C++:  int GetHardwareInfo(uchar *HardwareData)
Delphi: GetHardwareInfo(var HardwareData: byte): integer;
VB:     GetHardwareInfo(ByRef HardwareData As Byte) As Long
```

GetNumberOfDevices

The GetNumberOfDevices function returns the number of Win-I2CUSB adapters currently enumerated on the user's PC.

```
C/C++:  int GetNumberOfDevices(void)
Delphi: GetNumberOfDevices: integer;
VB:     GetNumberOfDevices() As Long
```

SelectBySerialNumber

Win-I2CUSB allows you to communicate with a specific adapter based on its serial number. Just use the SelectBySerialNumber function to specify the serial number (labeled on every Win-I2CUSB adapter) you would like to communicate with and then all communications will continue with this adapter until a new serial number is specified. This is a simple way to identify the USB adapter when multiple Win-I2CUSB adapters are present in your system.
The function returns a '0' if the serial number is not found and a '1' if the serial number has been found.

```
C/C++:  int SelectBySerialNumber(int SerialNumber)
Delphi: SelectBySerialNumber(SerialNumber: integer): integer;
VB:     SelectBySerialNumber(ByVal SerialNumber As Long) As Long
```

GetSerialNumbers

This function takes a pointer to an array which will be loaded with the serial numbers of the Win-I2CUSB adapters attached to the user's system. The function returns the number of Win-I2CUSB adapters attached.

```
C/C++:  int GetSerialNumbers(int *SerialNumbers);
Delphi: GetSerialNumbers (var SerialNumbers: integer): integer;
VB:     GetSerialNumbers (ByRef SerialNumbers As Long) As Long
```

Get_DLL_Version

This function returns the version of the USBtoI2Cpro.dll file. Normally, it will not be necessary to call this function unless you need to know the specific version of the DLL is installed. We have found this function to be useful for development environments that do not automatically load the DLL into memory until a function is called (for example, console applications).

```
C/C++:  int Get_DLL_Version(void);
Delphi: Get_DLL_Version: integer;
VB:     Get_DLL_Version () As Long
```

ShutdownProcedure

This function should be called when the application using the DLL is closed.

```
C/C++:  void ShutdownProcedure(void);
Delphi: ShutdownProcedure;
VB:     ShutdownProcedure()
```

Win-I2CUSBDLL

IO Functions

There are three sources of general purpose IO available on the Win-I2CUSB hardware:

1. There is a dedicated IN and a dedicated OUT pin. These are always available, even when both the I2C and SPI buses are in use
2. The I2C pins may be used as open-drain IO. The I2C functions must be disabled for these pins to be used as IO.
3. The SPI pins may be used as quasi-bidirectional IO. The SPI functions must be disabled for these pins to be used as IO.

Read_IO

This function returns the state of the general purpose input (IN) port on the Win-I2CUSB hardware. The function returns a '1' for a high logic level and a '0' for a low logic level.
The IN pin is a Schmitt-Trigger input with the following characteristics:

```
Vth(HL) negative-going threshold voltage   0.7V (min)
                                           1.3V (typical)
Vth(LH) positive-going threshold voltage   2.0V (typical)
                                           2.3V (max)
```

Note that the microcontroller is a 3.3V device but this input is 5V tolerant.

```
C/C++:  int Read_IO(void);
Delphi: Read_IO: integer;
VB:     Read_IO() As Long
```

Write_IO

This function writes a value to the general-purpose output (OUT) port on the Win-I2CUSB hardware. The function takes a '1' for a high logic level and a '0' for a low logic level.
The Output Port has the following characteristics:

```
Voh = 3.1V (typical @ 20 µA)
      3.0V (min @ 20µA)
Vol = 0.2V (typical @ 3.2mA)
      0.3V (max @ 3.2mA)
```

```
C/C++:  int Write_IO(int OutputState);
Delphi: Write_IO(OutputState: integer): integer;
VB:     Write_IO(ByVal OutputState As Long) As Long
```

Disable_I2C

The Disable_I2C function disables the I2C functionality on the Win-I2CUSB hardware. The I2C function is enabled on hardware after reset so this function must be called before the I2C pins (SCL and SDA) can be used as GPIO. After the function has been called, the pins are configured as open-drain IO. If the communication to the hardware was successful, the function returns a '1' while a '0' is returned if unsuccessful.

```
C/C++:  int Disable_I2C (void);
Delphi: Disable_I2C: integer;
VB:     Disable_I2C () As Long
```

Win-I2CUSBDLL

Enable_I2C

The Enable_I2C function re-enables the I2C functionality on the Win-I2CUSB hardware. The I2C functionality is disabled after the Disable_I2C function is called so this function can be called to once again enable the I2C interface.

```
C/C++:  int Enable_I2C(void);
Delphi: Enable_I2C: integer;
VB:     Enable_I2C () As Long
```

GPIO_I2C_Write

The GPIO_I2C_Write function writes two bits of IO data to the I2C pins. Disable_I2C must be called before using these pins as GPIO. If the communication to the hardware was successful, the function returns a '1' while a '0' is returned if unsuccessful.
The data byte will be sent to the I2C interface in the following format:

x	x	x	x	x	x	SDA	SCL

```
C/C++:  int GPIO_I2C_Write (uchar GPIOData);
Delphi: GPIO_I2C_Write (GPIOData : byte): integer;
VB:     GPIO_I2C_Write (ByVal GPIOData As Byte) As Long
```

GPIO_I2C_Read

The GPIO_I2C_Read function reads one byte of data from the I2C pins. Disable_I2C must be called before using these pins as GPIO.
The data byte will be returned from the I2C interface in the following format:

x	x	x	x	x	x	SDA	SCL

```
C/C++:  uchar GPIO_I2C_Read (void);
Delphi: GPIO_I2C_Read: byte;
VB:     GPIO_I2C_Read () As Byte
```

Disable_SPI

The Disable_SPI function disables the SPI functionality on the Win-I2CUSB hardware. The SPI function is enabled on hardware reset so this function must be called before the SPI pins SCLK, MISO, MOSI, and SSN can be used as GPIO. After the function has been called, the pins are configured as quasi bidirectional. If the communication to the hardware was successful, the function returns a '1' while a '0' is returned if unsuccessful.

```
C/C++:  int Disable_SPI (void);
Delphi: Disable_SPI: integer;
VB:     Disable_SPI () As Long
```

Enable_SPI

The Enable_SPI function re-enables the SPI functionality on the Win-I2CUSB hardware. The SPI functionality is disabled after the Disable_SPI function is called so this function can be called to enable SPI communications once again.

```
C/C++:  int Enable_SPI (void);
Delphi: Enable_SPI: integer;
```

```
VB:     Enable_SPI () As Long
```

GPIO_SPI_Write

The GPIO_SPI_Write function writes four bits of data to the SPI pins. Disable_SPI must be called before using these pins as GPIO. If the communication to the hardware was successful, the function returns a '1' while a '0' is returned if unsuccessful.
The data byte will be sent to the SPI interface in the following format :

x	x	x	x	MOSI	MSIO	SSN	SCLK

```
C/C++:  int GPIO_SPI_Write (uchar GPIOData);
Delphi: GPIO_SPI_Write (GPIOData : byte): integer;
VB:     GPIO_SPI_Write (ByVal GPIOData As Byte) As Long
```

GPIO_SPI_Read

The GPIO_SPI_Read function reads one byte of data from the SPI pins. Disable_SPI must be called before using these pins as GPIO.
The data byte will be returned from the SPI interface in the following format:

x	x	x	x	MOSI	MSIO	SSN	SCLK

```
C/C++:  uchar GPIO_SPI_Read (void);
Delphi: GPIO_SPI_Read: byte;
VB:     GPIO_SPI_Read () As Byte
```

Win-I2CUSBDLL

I2C Specific Functions

Win-I2CUSBDLL provides a large number of I2C specific functions to easily provide communications with any i2c device. In reality, we only needed to provide two functions: I2CWrite and I2CRead, but in order to ease integration as well as to improve the performance of Win-I2CUSBDLL, we have included a total of eleven i2c message related functions. These have been designed to help you integrate i2c into your application a well as to give superior performance.

GetI2CFrequency

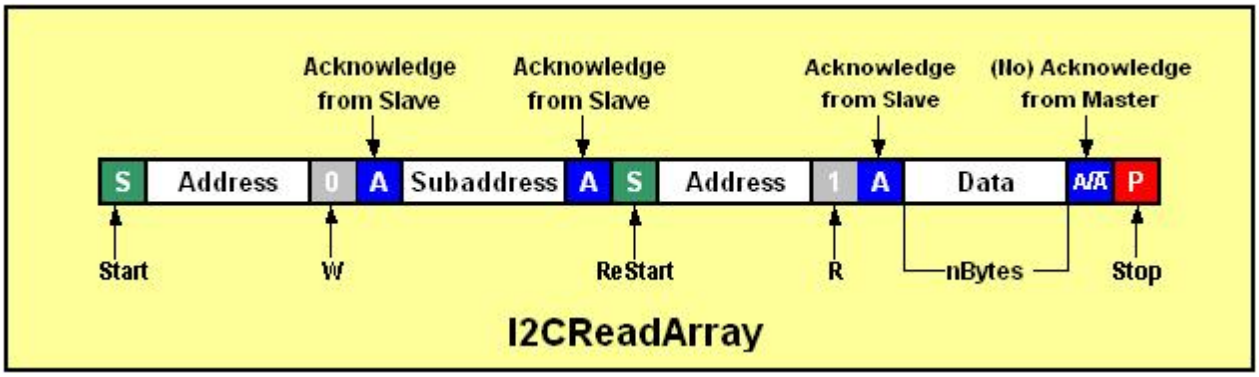
This function takes no arguments and returns the current I²C clock frequency.

```
C/C++:  int GetI2CFrequency(void)
Delphi: GetI2CFrequency: integer;
VB:     GetI2CFrequency() As Long
```

I2CReadArray

The I2CReadArray function takes four arguments: the device (slave) address, the device subaddress, the number of bytes to read, and a pointer to an element within an array of bytes. It is the calling program's responsibility to allocate the correct memory space for the array. The function ensures that the lsb of the address is appropriate ('1' or '0' depending on Write or Read) before it is sent to the target device.
The maximum number of data bytes (nBytes) to be read during the I2CReadArray function is currently set to a maximum of 256 bytes.

```
C/C++:  uchar I2CReadArray(uchar address, uchar subaddress, short int nBytes,
        uchar *ReadData);
Delphi: I2CReadArray(address,subaddress:byte;nBytes:word; var ReadData:byte):byte;
VB:     I2CReadArray(ByVal address, ByVal subaddress As Byte, ByVal nBytes
        As Integer, ByRef ReadData As Byte) As Byte
```



I2CReadArrayDB

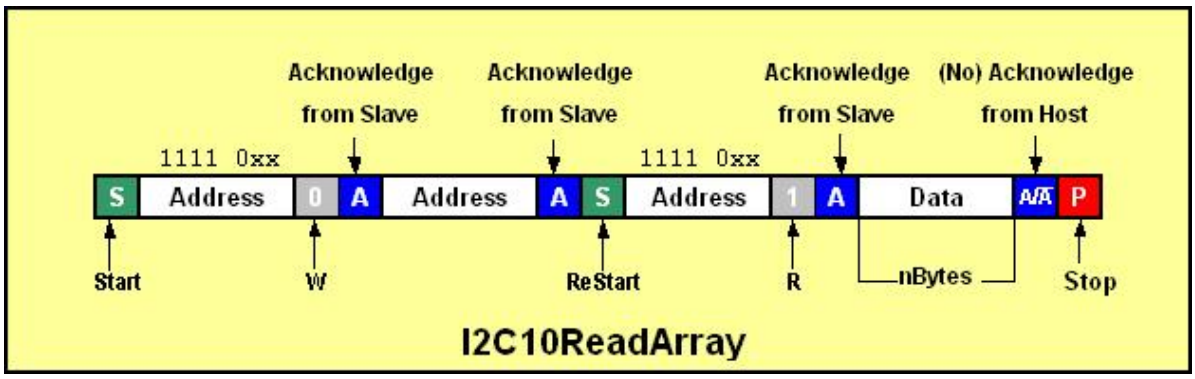
This function will generally be used for reading an eeprom of 32kbits or larger that require two subaddresses. The I2CReadArrayDB function takes five arguments: the device (slave) address, the device's high subaddress, low subaddress, the number of bytes to read, and a pointer to an element within an array of bytes. It is the calling program's responsibility to allocate the correct memory space for the array. The function ensures that the lsb of the address is appropriate ('1' or '0' depending on Write or Read) before it is sent to the target device.

The maximum number of data bytes (nBytes) to be read during the I2CReadArrayDB function is currently set to a maximum of 256 bytes.

```
C/C++:  uchar I2CReadArrayDB(uchar address, uchar saHigh, uchar saLow,short int
        nBytes, uchar *ReadData);
Delphi: I2CReadArrayDB(address,subaddressHigh,subaddressLow:byte;nBytes:word; var
        ReadData:byte):byte;
VB:     I2CReadArrayDB(ByVal address, ByVal saHigh As Byte, ByVal saLow As Byte,
        ByVal nBytes As Integer, ByRef ReadData As Byte) As Byte
```

I2C10ReadArray

The I2C10ReadArray function (read an array with 10-bit device addressing) is similar to the I2CReadArray function; however, it uses 10-bit I²C addressing. The I²C specification states that the 10-bit address has the following format:
First byte: 1111 0xx + R/W bit
Second byte: xxxx xxxx; where x = the 10 bits of address
The function takes the received 16-bit address data and uses the lower 10 bits to generate the proper 10-bit I²C compliant format. A subaddress is also sent after the second byte of the address (not shown in diagram below).
The maximum number of data bytes to be read during the I2C10ReadArray function is currently set to a maximum of 256 bytes.

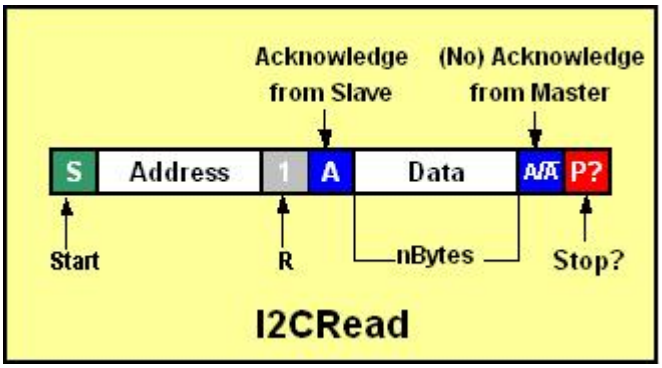



```
C/C++:  uchar I2C10ReadArray(short int address, uchar subaddress, short int
        nBytes, uchar *ReadData)
Delphi: I2C10ReadArray(address: word, subaddress: byte; nBytes: word;
        var ReadData: byte): byte;
VB:     I2C10ReadArray(ByVal address As Integer, ByVal subaddress As Byte,
        ByVal nBytes As Integer, ByRef ReadData As Byte) As Byte
```

I2CRead

The I2CRead function (read an array with no subaddress) is similar to the I2CReadArray function; however, it does not perform the write to a subaddress before the read is transmitted.
This function takes four arguments: the device address, the number of bytes to read, a pointer to an element within an array of bytes where the bytes will be stored, and finally, a variable indicating whether a Stop condition will be sent at the end of the transmission. It is the calling program's responsibility to allocate the correct memory space for the array. The function ensures that the lsb of the address is set to a '1' before it is sent to the target device.
The maximum number of data bytes that can be read during the I2CRead function is currently set to a maximum of 500 bytes.

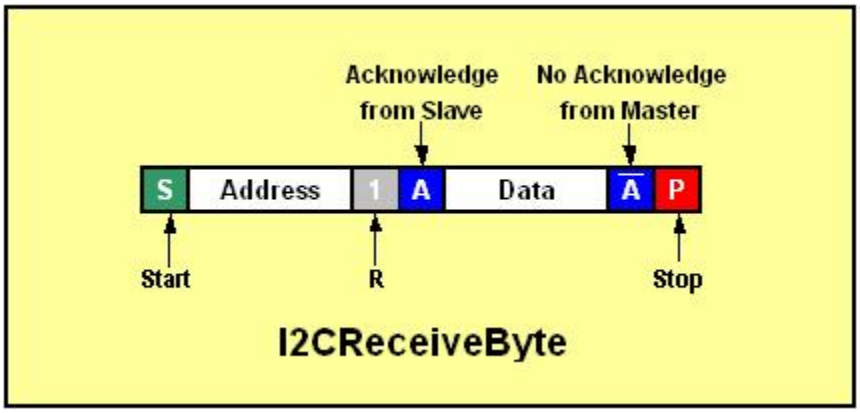
```
C/C++:  uchar I2CRead(uchar address, short int nBytes, uchar *ReadData,
        short int SendStop)
Delphi: I2CRead(address: byte; nBytes: word; var ReadData: byte; SendStop:
        LongBool): byte;
VB:     I2CRead(ByVal address As Byte, ByVal nBytes As Integer, ByRef ReadData As
        Byte, ByVar SendStop As Boolean) As Byte
```



I2CReceiveByte

The I2CReceiveByte function reads one byte from an I²C Bus/SMBus device. The function takes the device address and a pointer to a memory location used to store the data byte. I2CReceiveByte returns any error condition it encounters. The function ensures that the lsb of the address is a '1' before it is sent to the target device.

```
C/C++:  uchar I2CReceiveByte (uchar address, uchar *ReadData)
Delphi: I2CReceiveByte (address: byte; var ReadData: byte): byte;
VB:     I2CReceiveByte (ByVal address As Byte,ByRef ReadData As Byte) As Byte
```

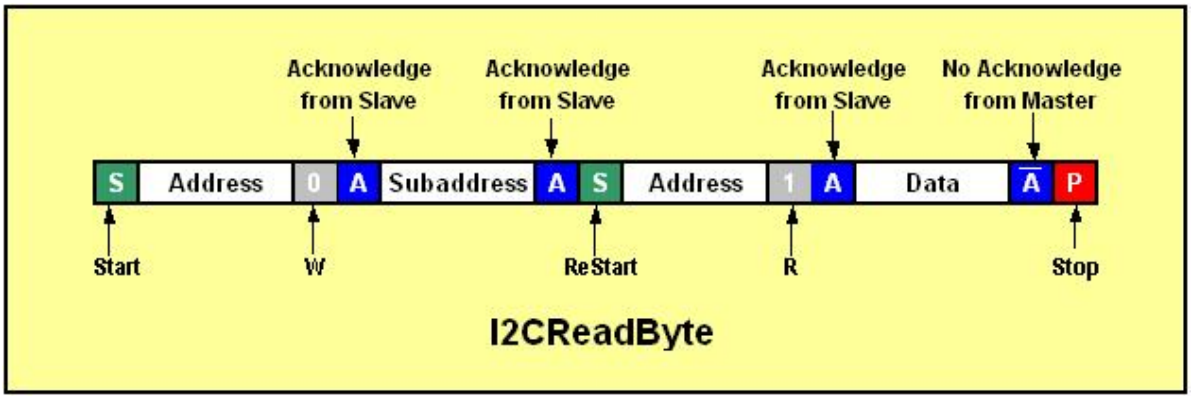


I2CReadByte

The I2CReadByte function reads one byte from an I²C Bus/SMBus device. The function takes the device address, the subaddress and a pointer to a memory location to store the data byte. I2CReadByte returns any error condition it encounters. The function ensures that the lsb of the address is a '1' before it is sent to the target device.

```
C/C++:  uchar I2CReadByte (uchar address, uchar subaddress, uchar *ReadData);
Delphi: I2CReadByte (address, subaddress: byte; var ReadData: byte): byte;
VB:     I2CReadByte (ByVal address As Byte, ByVal subaddress As Byte,
```

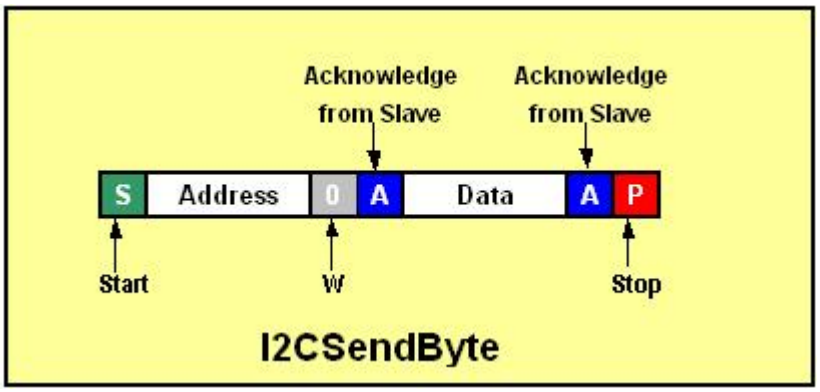
```
ByRef ReadData As Byte) As Byte
```



I2CSendByte

The I2CSendByte function writes one byte to an I²C Bus/SMBus device. The function takes the device address and one data byte. I2CSendByte returns any error condition it encounters. The function ensures that the lsb of the address is a '1' before it is sent to the target device.

```
C/C++:  uchar I2CSendByte (uchar address, uchar DataByte);
Delphi: I2CSendByte (address: byte; DataByte: byte): byte;
VB:     I2CSendByte (ByVal address As Byte, ByVal DataByte As Byte) As Byte
```

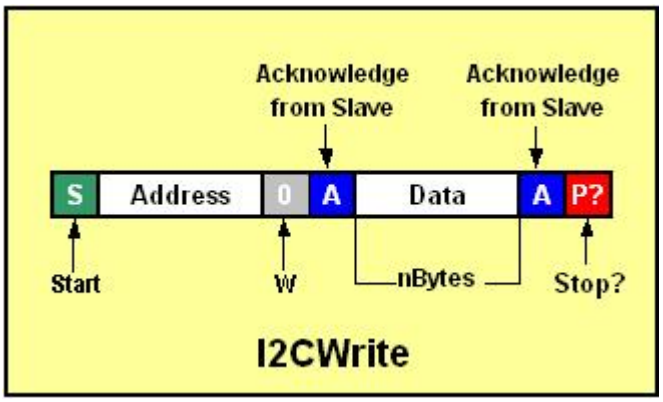


I2CWrite

The I2Cwrite function is a generic i2c write function. It takes four parameters: device address, number of bytes to be sent, and a pointer to an element within an array of bytes, followed by a Boolean value used to indicate if a Stop condition is required at the end of the transmission. The function ensures that the lsb of the address is a '0' before it is sent to the target device. The function returns any error condition it encounters.
The DLL is currently set to write up to a maximum of 500 bytes in one I2CWrite transmission.

```
C/C++:  uchar I2CWrite (uchar address, short int nBytes, uchar *WriteData,
        short int StopCondition);
Delphi: I2CWrite (address: byte; nBytes: word; var WriteData: byte; StopCondition:
        LongBool): Byte;
```

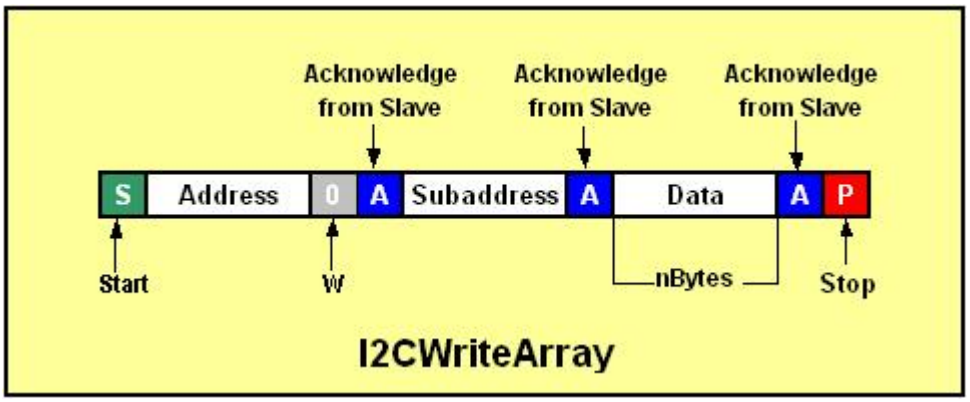
```
VB:     I2CWrite (ByVal address As Byte, ByVal nBytes As Integer, ByRef WriteData
        As Byte, StopCondition As Bool) As Byte
```



I2CWriteArray

The I2CWriteArray takes four parameters: device address, device subaddress, number of bytes to be sent, and a pointer to an element within an array of bytes. The function ensures that the lsb of the address is a '0' before it is sent to the target device. The function returns any error condition it encounters.
The DLL is currently set to write up to a maximum of 500 data bytes in one I2CWriteArray transmission.

```
C/C++:  uchar I2CWriteArray (uchar address, uchar subaddress; short int nBytes;
        uchar *WriteData);
Delphi: I2CWriteArray (address, subaddress: byte; nBytes: word; var WriteData:
        byte): byte;
VB:     I2CWriteArray (ByVal address As Byte, ByVal subaddress As Byte,
        ByVal nBytes As Integer, ByRef WriteData As Byte) As Byte
```



I2CWriteArrayDB

The I2CWriteArrayDB is generally used to write to eeproms larger than 32kbits that require two subaddresses to define a memory location within the device. The I2CWriteArrayDB takes five parameters: device address, device high and low subaddresses, number of bytes to be sent, and a pointer to an element within an array of bytes. The function ensures that the lsb of the address is a '0' before it is sent to the target device. The function returns any error condition it encounters.
The DLL is currently set to write up to a maximum of 500 data bytes in one I2CWriteArrayDB transmission.

```
C/C++:  uchar I2CWriteArrayDB (uchar address, uchar saHigh, uchar saLow, short int
        nBytes, uchar *WriteData);
Delphi: I2CWriteArrayDB (address, saHigh, saLow: byte; nBytes: word; var
        WriteData: byte): byte;
VB:     I2CWriteArrayDB (ByVal address As Byte, ByVal saHigh As Byte, ByVal saHigh
        As Byte, ByVal nBytes As Integer, ByRef WriteData As Byte) As Byte
```

I2C10WriteArray

The I2C10WriteArray function (write an array with 10-bit device addressing) is similar to the I2CWriteArray function; however, it uses 10-bit I²C addressing. The I²C specification states that the 10-bit address has the following format:

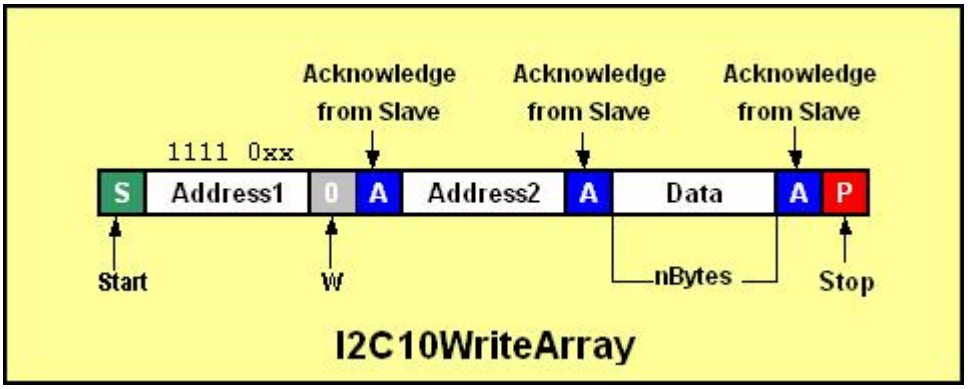
First byte: `1111 0xx + R/W` bit

Second byte: `xxxx xxxx`; where x = the 10 bits of address

The function takes the received 16-bit address data and uses the lower 10 bits to generate the proper 10-bit I²C compliant format.

The DLL is currently set to write up to a maximum of 256 data bytes (nBytes) in one I2C10WriteArray transmission.

A subaddress is also sent after the second byte of the address (not shown in diagram below), followed by the data.



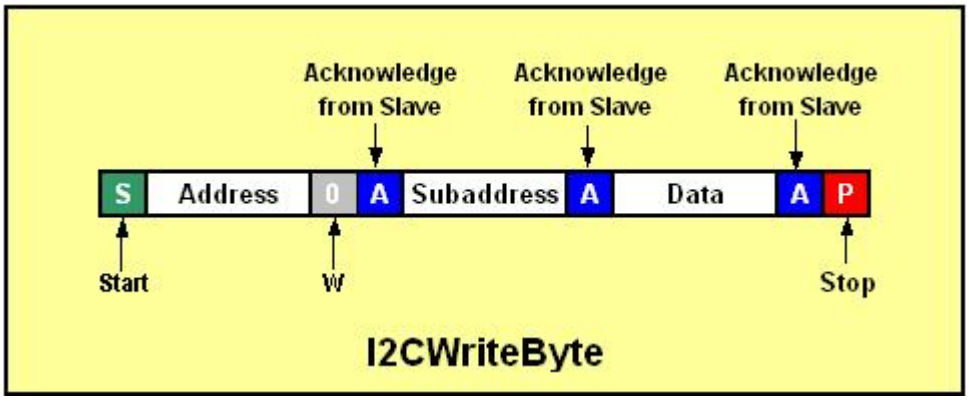

```
C/C++:  uchar I2C10WriteArray (short int address, uchar subaddress,
        short int nBytes, uchar *WriteData);
Delphi: I2C10WriteArray (address, subaddress: byte; nBytes: word;
        var WriteData: byte): byte;
VB:     I2C10WriteArray (ByVal address As Integer, ByVal subaddress As Byte,
        ByVal nBytes As Integer, ByRef WriteData As Byte) As Byte
```

I2CWriteByte

The I2CWriteByte function writes one data byte to an I²C bus device. The function takes three parameters: the device address, the subaddress, and a single data byte and returns any error condition it encounters. The function ensures that the lsb of the address is a '0' before it is sent to the target device.

```
C/C++:  uchar I2CWriteByte (uchar address, uchar subaddress, uchar Data);
Delphi: I2CWriteByte (address, subaddress, Data: byte): byte;
```

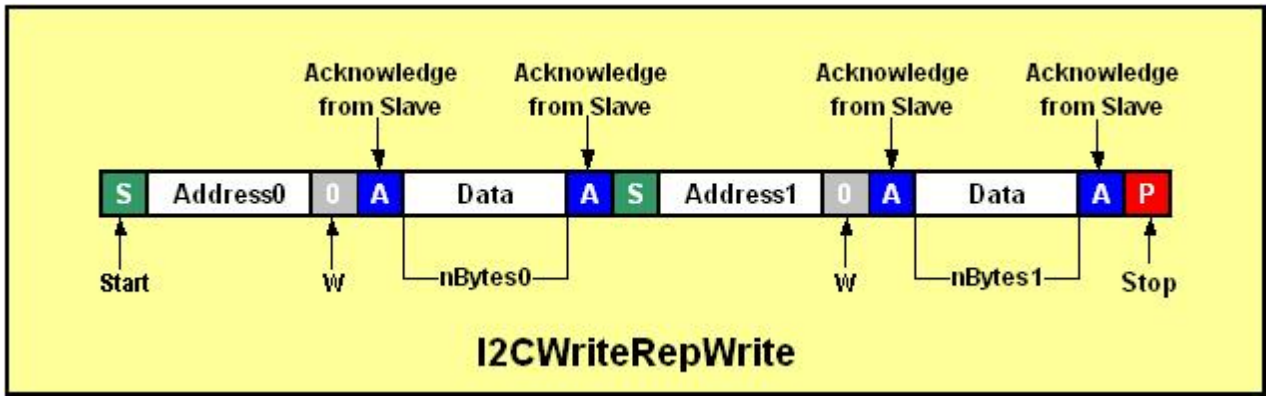
```
VB:     I2CWriteByte (ByVal address As Byte, ByVal subaddress As Byte, ByVal Data As
        Byte) As Byte
```



I2CWriteRepWrite

The I2CwriteRepWrite function writes two i2c messages separated by a Restart condition. Each i2c message is defined by three parameters: the address, the number of bytes in the message, and a pointer to the data to be sent. The function ensures that the lsb of the addresses are '0' before they are sent to the target device.
The maximum number of data bytes (nBytes0 + nBytes1) that can be sent in the two messages is set at 500 bytes.
This function is useful for a device such as a large eeprom which requires an address and two subaddresses to define where to write the data.

```
C/C++:  uchar I2CWriteRepWrite (uchar address0, short int nBytes0, uchar *
        WriteData0, uchar address1, short int nBytes1, uchar * WriteData1);
Delphi: I2CWriteRepWrite (address0: byte; nBytes0: short int; var WriteData0: byte;
        address1: byte; nBytes1: short int; var WriteData1: byte): byte;
VB:     I2CWriteRepWrite (ByVal address0 As Byte, ByVal nBytes0 As Integer, ByRef
        WriteData0 As Byte, ByVal address1 As Byte, ByVal nBytes1 As Integer, ByRef
        WriteData1 As Byte) As Byte
```



SetI2CFrequency

This function sets the I²C clock frequency to the value (in thousands of Hz) passed by the user's program. The frequency must be a positive integer. If a frequency is selected which is above the maximum frequency, the dll will set the frequency to the maximum I²C frequency that the Win-I2CUSB Hardware is capable of achieving, currently 1000 kHz. The Hardware is not capable of

achieving every discrete frequency so it will choose the closest available frequency. The actual frequency used by the Win-I2CUSBhardware will be returned by the function. The minimum frequency is 15.7 kHz so if a value is requested which is lower than this; the Win-I2CUSB adapter will be set to the minimum value.

```
C/C++:  int SetI2CFrequency (int frequency);
Delphi: SetI2CFrequency (frequency: integer): integer;
VB:     SetI2Cfrequency (ByVal frequency As Long) As Long
```

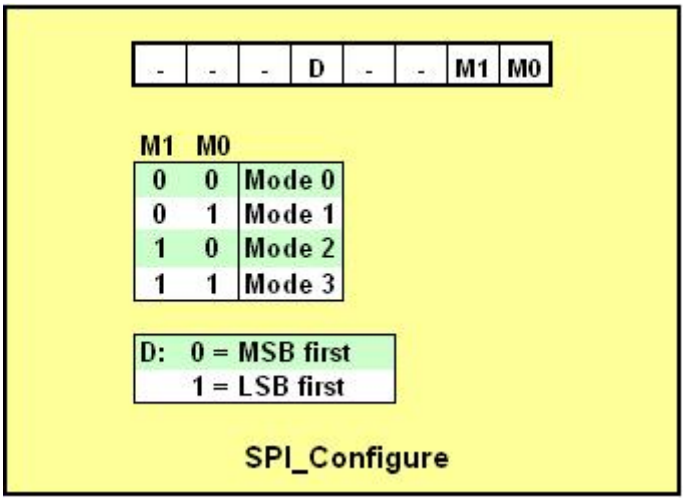
Win-I2CUSBDLL

SPI Specific Functions

SPI_Configure

The SPI_Configure function takes one byte that defines the configuration of the SPI master.
The two low order bits M1 and M0 define the SPI mode while the D bit defines whether the data is transmitted MSB or LSB first.

```
C/C++:  uchar SPI_Configure (uchar SPI_Mode);
Delphi: SPI_Configure (SPI_Mode: byte): byte;
VB:     SPI_Configure (ByVal SPI_Mode As Byte) As Byte
```



SPI_SetFrequency

The SPI_SetFrequency function takes a value that defines the frequency in KHz and configures the Win-I2CUSB adapter to transmit at an appropriate frequency. The Win-I2CUSB adapter has the ability to transmit at four specific frequencies. The hardware will be programmed to transmit at the following frequencies:

```
C/C++:  int SPI_SetFrequency (int frequency);
Delphi: SPI_SetFrequency (frequency: integer): integer;
VB:     SPI_SetFrequency (ByVal frequency As Long) As Long
```

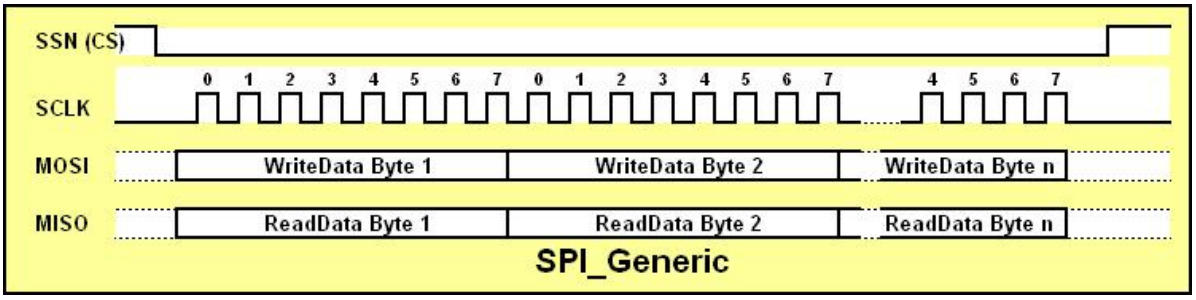
Programmed value	Actual
0 to 249	125
250 to 999	250
1000 to 3999	1000
4000 to >4000	4000

SPI_Generic

The SPI_Generic function writes the number of bytes defined by nBytes with values defined in an array WriteData. As the data is written, the Win-I2CUSB adapter also reads the data into the array defined by pointer ReadData. The number of bytes sent and received will equal nBytes.
The maximum value of nBytes is 500 bytes.

```
C/C++:  uchar SPI_Generic (short int nBytes, uchar *WriteData, uchar *ReadData);
```

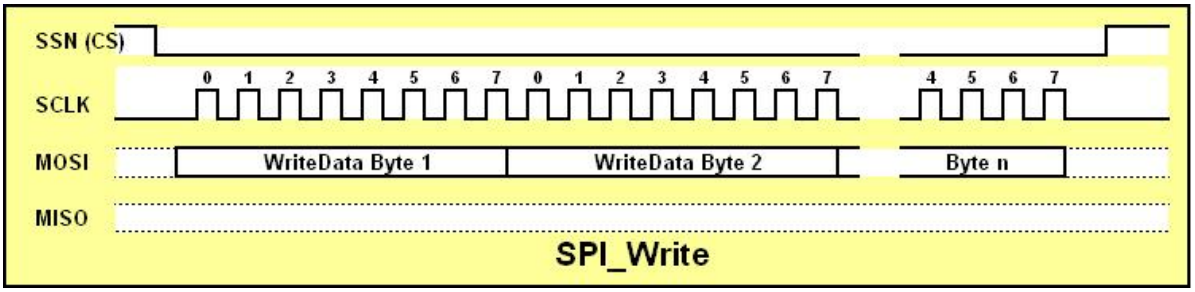
```
Delphi: SPI_Generic (nBytes: word; var WriteData: byte; var ReadData: byte): byte;
VB:     SPI_Generic (ByVal nBytes As Integer, ByRef WriteData As Byte,
        ByRef ReadData As Byte) As Byte
```



SPI_Write

The SPI_Write function writes the number of bytes defined by nBytes with values defined by pointer WriteData. The returned value will indicate if the transmission was successful. The maximum value of nBytes is 500 bytes.

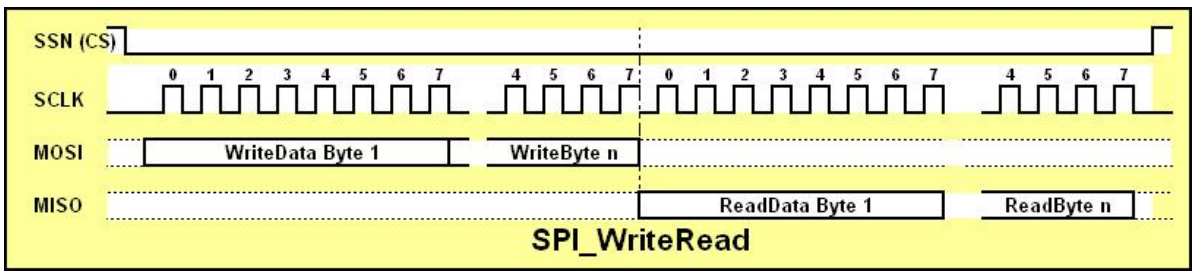
```
C/C++:  uchar SPI_Write (short int nBytes, uchar * WriteData);
Delphi: SPI_Write (nBytes: word; var WriteData: byte): byte;
VB:     SPI_Write (ByVal nBytes As Integer, ByRef WriteData As Byte) As Byte
```



SPI_WriteRead

The SPI_WriteRead function writes an array of data to an SPI slave device and reads an array from it. The nBytes0 value defines the number of bytes written while nBytes1 defines the number of bytes read. WriteData defines a pointer to the array of data to be written while ReadData points to an array where the nBytes1 bytes of data will be returned by the device.
The maximum size of nBytes0 and nBytes1 is 500 bytes (each).

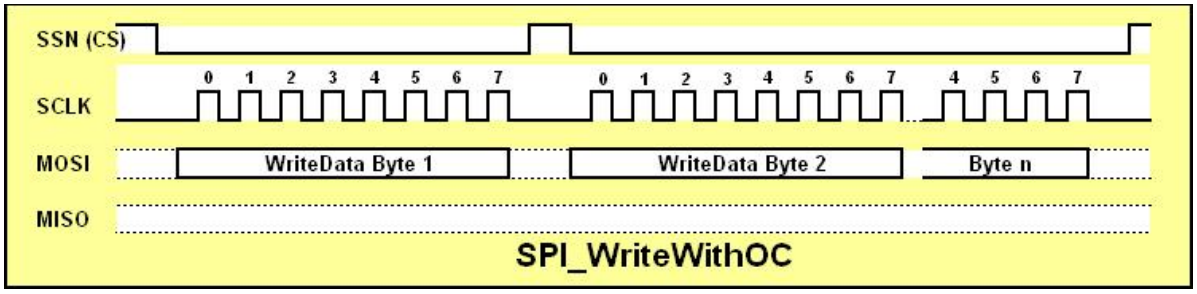
```
C/C++:  uchar SPI_WriteRead (short int nBytesWrite, short int nBytesRead,
        uchar * WriteData, uchar * ReadData);
Delphi: SPI_WriteRead (nBytesWrite, nBytesRead: word; var WriteData: byte;
        var ReadData: byte): byte;
VB:     SPI_WriteRead (ByVal nBytesWrite As Integer, ByVal nBytesRead As Integer,
        ByRef WriteData As Byte, ByRef ReadData As Byte) As Byte
```



SPI_WriteWithOC

The SPI_WriteWithOC function allows you to send an OpCode during one CS cycle and then data in another CS cycle. This can be useful for devices such as eeproms which require the user to enable a write before the write cycle is initiated. The first byte in the WriteData array will be sent in the first CS cycle while the remaining bytes will be sent in the second CS cycle. The maximum number of bytes which can be sent in one packet is 500 bytes.

```
C/C++:  uchar SPI_WriteWithOC (short int nBytes, uchar * WriteData);
Delphi: SPI_WriteWithOC (nBytes: word; var WriteData: byte): byte;
VB:     SPI_WriteWithOC (ByVal nBytes As Integer, ByRef WriteData As Byte) As Byte
```

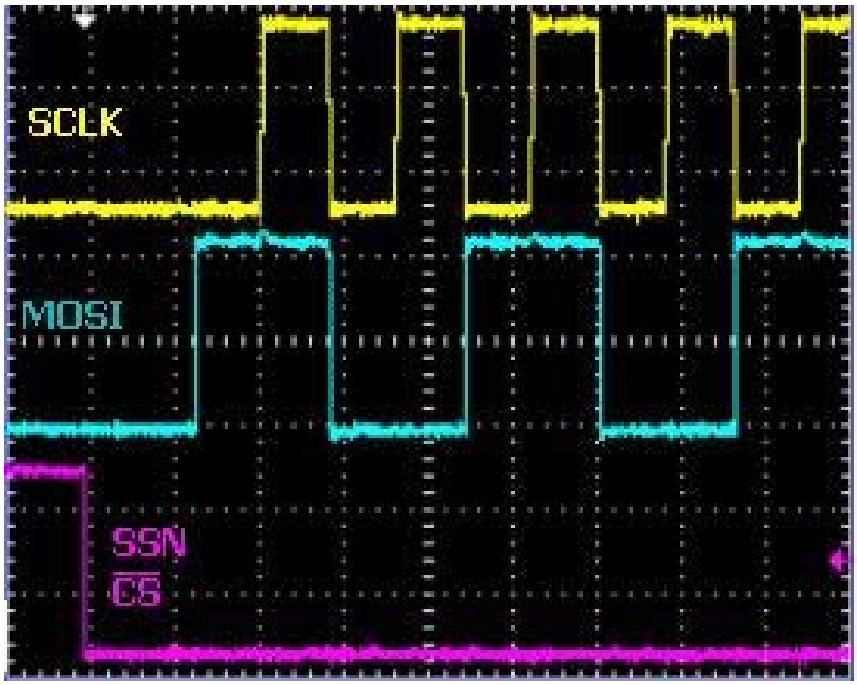


Win-I2CUSBDLL

APPENDIX A

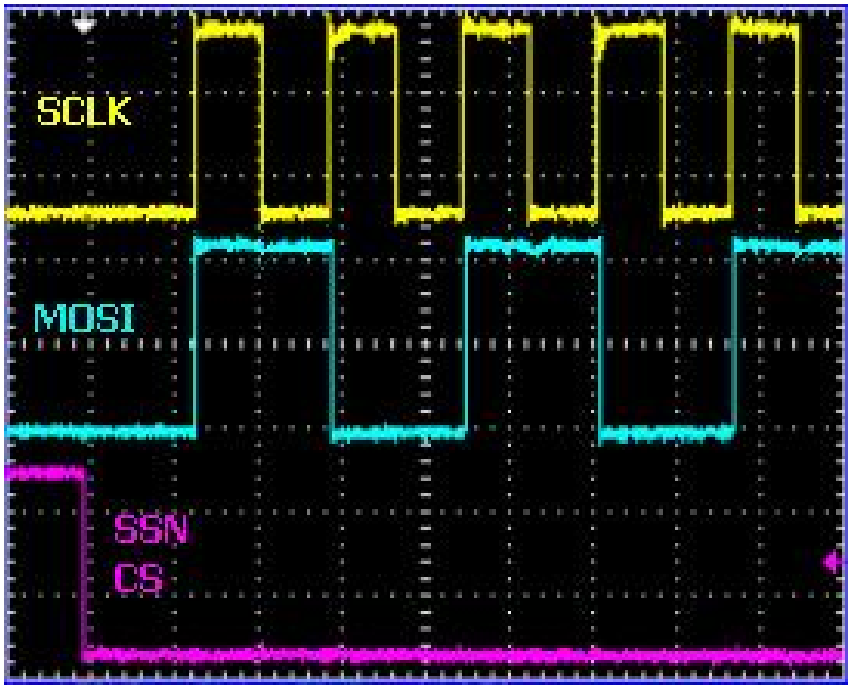
SPI Modes of Operation

SPI is defined by both a clock polarity and phase. Here are the four possible modes of operation, all are support by the Win-I2CUSBDLL.



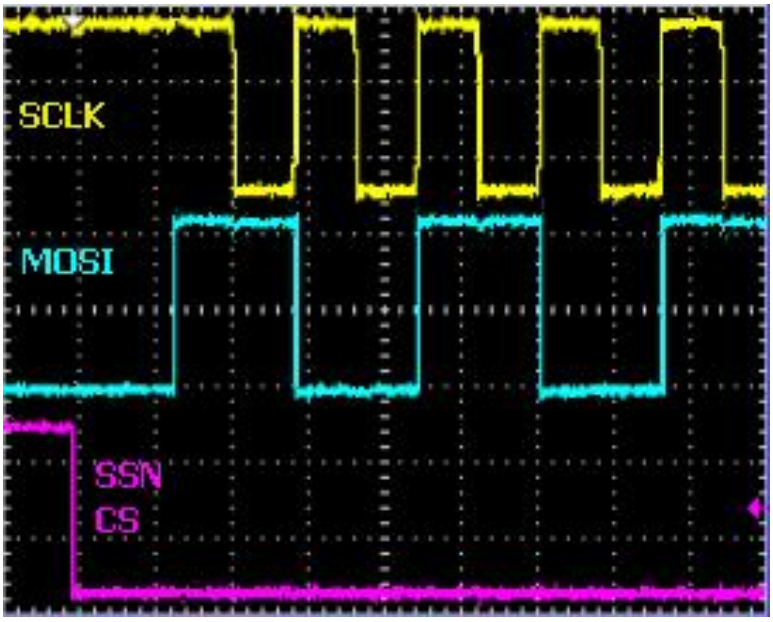
SPI MODE 0

Mode 0 operation is characterized by the clock (SCLK) starting at a low level. The data is sampled on the leading edge of the clock.



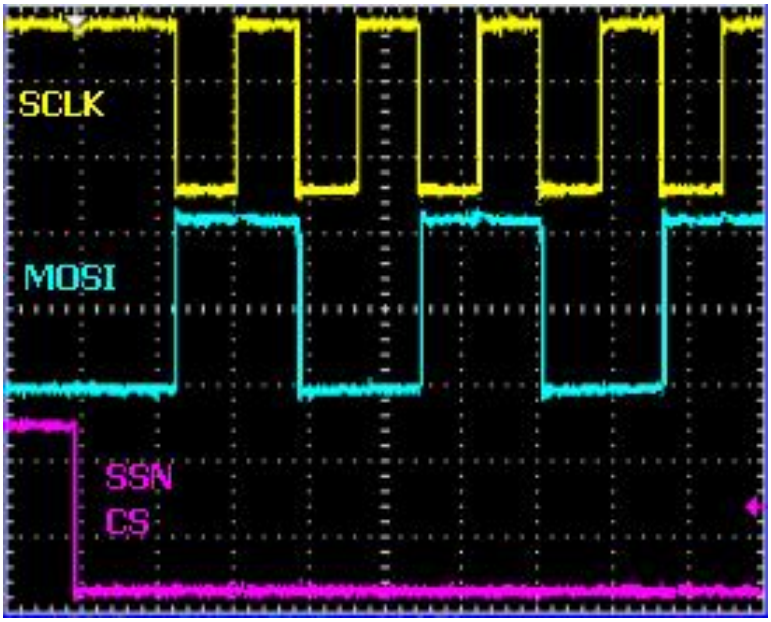
SPI MODE 1

Mode 1 operation is characterized by the clock (SCLK) starting at a low level. The data is sampled on the falling edge of the clock.



SPI MODE 2

Mode 2 operation is characterized by the clock (SCLK) starting at a high level. The data is sampled on the falling edge of the clock.



SPI MODE 3

Mode 2 operation is characterized by the clock (SCLK) starting at a high level. The data is sampled on the rising edge of the clock.

Error Codes

The following error codes are returned by the various functions in WinI2CUSBpro.dll:

0x00: No error
0x01: Address not Acknowledged
0x02: Data not Acknowledged
0x07: Arbitration lost
0x08: I2C Time Out
0x0A: Transmission aborted
0x80: Unsupported function (make sure you have the latest firmware)
0xFF: Hardware not detected or USB error